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quite plain. The brooches or fibulæ are composed of an alloy of silver. One of them is of remarkable size, being thirteen and a half inches in length, and six inches in breadth. The front is gilt, and covered with various interlaced patterns, and is one of the finest examples of its class remaining in Ireland.

L.—On a Modification of Regnault's Condensing Hygrometer, with Observations on the Psychrometer. By M. Donovan, M. R. I. A., Member of the Philadelphia College of Pharmacy.

[Read April 12, 1869.]

The dulness produced on the outside of a glass vessel by pouring water into it much colder than itself has given origin to a number of instruments intended to present that result with facility and precision, as a means of ascertaining the quantity of aqueous vapour contained, at any particular moment, in a certain volume of air—of determining the temperature at which it would begin to precipitate, and of discovering what quantity of water the atmosphere could still hold in addition to that which it already contains.

Amongst these, Daniell's Hygrometer held a conspicuous place: it was, however, far from being a satisfactory instrument. Its imperfections have been fully stated by Regnault. ("Annales de Chimie," xv., p. 194).

Observing these imperfections, M. Regnault contrived a Hygrometer on the principle of condensation, which he found to act satisfactorily. The following is his account of it:—An exceedingly thin and highly polished hollow silver cylinder, the diameter of which is 0·787 inch, and its length 1·77 inch, is accurately fitted, by grinding, to a glass tube, open at both ends. The upper end of this tube is closed with a cork, which is traversed through its axis by the stem of a very sensible and correct Thermometer. The bulb, or rather the cylindrical reservoir, of the Thermometer occupies the axis of the silver cylinder, or thimble as Regnault calls it. A very slender air tube of glass, open at both ends, passes through another hole in the same cork, and descends nearly to the bottom of the thimble. The upper part of the containing glass tube has a small lateral tubulature, which communicates, by a slender leaden tube, with a distant aspirator filled with water. When the instrument is to be used, ether is poured into the thimble until it rise a little way above the bulb of the Thermometer. The water of the aspirator is then allowed to flow: air passes through the air tube, and issues out of its lower end through the ether, which is thus vaporized, and produces cold. This cooling process is to be cautiously continued until the temperature be found at which a faint cloudiness can be maintained on the silver thimble by the condensation of atmospheric moisture.

As it is necessary to know the temperature of the air at that moment, in order to determine the fraction of saturation, Regnault places another Thermometer in a second silver thimble and glass tube like the first, but unconnected with the aspirator, and not containing ether. Both thimbles being placed near each other on a proper stand, and being equally polished, the constrast presented by one, as soon as the dew begins to be formed on it, renders the deposition evident.

With regard to the advantages of this Hygrometer, M. Regnault observes, that the temperature of the ether must be uniform on account of the continual passage of air bubbles; the very thin silver thimble must be of the same temperature; the observer may be at a great distance, viewing the process through a small telescope, and hence exhalations are avoided.

Notwithstanding the advantages of this Hygrometer, it is not without some inconvenience, which, to be fully appreciated, must be experienced during its management. The cork, which admits the stem of the Thermometer and the air tube, being only ¾-inch diameter, and perforated by two holes, is much weakened, and is thus rendered difficult to be withdrawn without being broken, along with the Thermometer, so often as experiments may require. The junctures must be secured with cement, and re-cemented as often as it is necessary to renew the spoiled residue of ether. Any leakage would defeat the object. All this implies risk to so delicate an apparatus, as well as much trouble in its management.

There is another inconvenience which Regnault himself points out—namely, the bulk of the aspirator, and the necessity of procuring water enough to supply it, which might be difficult in an open country on an expedition of research. He observes, however, that the aspirator may be dispensed with, if a mouthpiece and stop-cock be affixed to the leaden tube. The operator thus breathes (*souffle*) through the ether, and thus produces cold; but, considering the anæsthetic effect of the ethereal vapour, the inspiration by this method might have disagreeable consequences, and the expiration would blow out the ether.

I have mentioned these inconveniences as my apology for venturing to propose a modification of an instrument coming from so high an authority. I now proceed to a description of it. On a circular brass foot is erected a brass pillar, twelve inches in height, carrying on its top a horizontal piece, at the under surface of which is screwed a brass socket pointing downwards. Into this socket is cemented a depending vertical glass tube, open at both ends, seven inches in length. The outside diameter of this tube must be such that it will fit into a silver cylinder made as thin as possible; into this cylinder the tube enters about half an inch, and is firmly fixed there by gluing. The silver cylinder, closed at the bottom, will contain ether without the possibility of escape in any other manner than in vapour through the top of the tube, when the pressure of the air is withdrawn. The cylinder is $2\frac{6}{10}$ inches in length, and half an inch in diameter. It is polished to the highest lustre. Within the glass tube is a Thermometer, the mercurial reservoir of which is cylindrical, and about the same length as the silver cylinder. When the Thermometer is in its place, and ether poured in, the mercurial reservoir—which for the future I shall call its bulb—is immersed. The graduated scale is fixed outside the glass tube, which contains the stem of the Thermometer, and the indications of the mercurial thread can easily be read through the tube with precision. The scale is graduated to every half-degree between 15° and 110°, and quarter-degrees or less can be easily read off. The Thermometer is cemented at top to a brass cap, carrying an adjusting screw, which permits the precise adaptation of the mercurial thread within to the freezing point marked on the scale without—an adaptation the more necessary, as the Thermometer sometimes requires to be taken out and cleansed from an oily matter deposited by the ether during its evaporation.

The brass socket, which sustains the glass tube and included Thermometer, has an air passage drilled through its axis, and continued through the horizontal piece down through the axis of the pillar to the edge of the circular brass foot, where it ends in a stop-cock; to this may occasionally be attached a flexible metal tube, * of the smallest bore, six or eight feet long, to the other end of which is occasionally connected a small exhausting syringe; the piston should work rather freely, as much exhaustion is not necessary; the valve should be of sheep's bladder.

The effect of this arrangement is, that by working the piston the glass tube containing the thermometer is more or less exhausted; the ether bubbles up, and evaporates rapidly or slowly as required; the silver cylinder, after a while, suddenly becomes dull with condensed atmospheric aqueous vapour, and the Thermometer within indicates the temperature at which the first dulness had taken place. This is the dew point, under certain restrictions, to be described hereafter.

In the bottom of the silver cylinder is soldered a very slender recurved silver tube, the bore of which is not quite one-twentieth of an inch; it communicates with the interior of the silver cylinder, not only at the bottom, but by three minute equidistant holes, where it passes up, and is soldered to the side of the ferule; it continues along the back of the thermometric scale, and terminates at the top in a slightly tapering, almost cylindrical funnel. Through this the ether is introduced, which then runs down into the cylinder beneath, fills it, and rises about half an inch into the glass tube, on which the cylinder is cemented. The above-mentioned cylindrical funnel serves another very important purpose that will be described hereafter.

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* Indian rubber, although more convenient, would be soon destroyed.

The slender silver tube not only admits ether to the cylinder, but permits air to pass through the four minute holes in streams of small bubbles, which, as in Regnault's Hygrometer, keep the ether in continued agitation, and therefore in an uniform temperature. The air vaporizes ether at each hole; both are drawn off by the exhaustion when the syringe is made to act, and cold is produced sufficient at all seasons to cause the deposition of atmospheric moisture, or even to freeze it on the silver cylinder.

It might be supposed, perhaps, that one aperture at the bottom of the cylinder, as in Regnault's instrument, might supply air in such a manner as to produce equalization of temperature. I found it otherwise. Cold is chiefly generated at the point where air is transmitted; the abstraction of heat takes place chiefly at the expense of the silver, and the ether is cooled as a secondary process. Accordingly, when I employed a cylinder with one opening in the bottom to admit air, the cloud appeared on the bottom long before it could be discovered on any other part; but when I procured a cylinder perforated with three additional holes, the cloud appeared on all parts at once. The holes must be made by means of the finest sewing needle, made into a drill; should they be larger than such a drill will make, the vacuum will be supplied with air from the uppermost holes alone, and there only will the condensation of vapour take place for some time.

On closely observing the formation of dew on a condensing Hygrometer, made by Negretti and Zambra according to the published instructions of M. Regnault, I found that this very result occurred; the obscuration took place at the bottom of the silver thimble, where the common air permeates the ether in a single stream; and not until the included thermometer had lowered two degrees more was the whole thimble clouded. It would, therefore, be always a question which, the initial or the final, was the true dew point.

Hitherto, to avoid confusion, I have described but one Thermometer; but in Regnault's instrument there is a second, fixed within an inch of the first, and parallel to it. The bulb of this Theromometer is, like the other, enclosed in a silver cylinder; but it contains no ether. One of its uses is to show, by contrast, when the other becomes dull with condensed vapour, and also to indicate the temperature of the air at the time of making the experiment. In my modification of the instrument I use a second Thermometer similarly placed with the same objects, but also with an additional one. This second Therometer is merely screened in front by a half silver cylinder—that is, a cylinder divided in the direction of its axis. This half cylinder is fixed to an arm, removable to one side when not in use. I employ this second Thermometer for a purpose that adds greatly to the utility of the instrument. The Psychrometer, or wet-bulb Thermometer, is much in use on account not only of giving the dew point by an easy calculation, but of its affording a certain amount of information by mere inspection. My second Thermometer acts in the capacity of a Psychrometer. Its long cylindrical reservoir of mercury is covered with a light casing of the finest cambric, sewed on in a single roll. The cambric is kept continually wet by a small glass fountain, which preserves a constant level of distilled water, and discharges it on the cambric, very little faster than it evaporates, by means of a woollen thread reaching from the fountain to the cambric; any redundant drops are received in a little glass basin below. Thus we have a Psychrometer always ready for observation, the wet bulb showing the depression, and the dry bulb, in its silver cylinder, affording the other element required for calculating the fraction of saturation. When the instrument is to be thus employed, the half silver cylinder, not being required, is to be removed to one side. Both silver surfaces should be kept as highly polished as possible; the wet point of a finger, with a very small portion of *rouge* (peroxide of iron), gently rubbed on the surface until dry, will leave it brilliant. When not in use, both should be kept continually covered with chamois-leather cases, any condensed moisture having been previously wiped off.*

The parts of the instrument are so placed with regard to each other, that, being comprised within a small compass, the whole may be covered by a French shade as a protection against dust and corrosion; but the French shade contributes to purposes of greater importance. M. Regnault observes—" When observations are made in the open air, it becomes evident how much the hygrometric state varies from one instant to another, in consequence of incessant changes of temperature. When the Hygrometer is maintained at the dew-point, the silver is observed to tarnish, and resume its lustre, according as the lightest breath comes from one side or the other." I may add that, on this account, it is often difficult or impracticable to discover what the dew-point is which truly represents the condition of the atmosphere. I have repeatedly encountered this difficulty. On one occasion it had been raining incessantly for seven hours; on working the exhausting syringe for a short time, the silver would suddenly become white all over, and in a few moments after it would become perfectly bright, although the mercury had been kept stationary all the time. It is on account of the continual changes which take place in the atmosphere that the indications of the Hygrometer are so uncertain and difficult to be ascertained in the open air—the proper place for observation. The passage of clouds, or even their vapours over the sun, will cause a perceptible rise or fall of temperature, according to the density of the cloud; and the changes will be easily discoverable by the varying effect of the syringe on the silver cylinder.

The French shade, if used in the following manner, will obviate the effects of these currents and damp breezes. The French shade being removed, let the syringe be cautiously used until the silver cylinder become dull. After a few moments, its lustre will be recovered, even though its Thermometer be kept stationary by a few short strokes of the piston; for the mercury is parting with the residue of the heat which it had not given off during the first action of the syringe. Let the French shade be now put on, and let the syringe be cautiously worked again until the silver be rendered dull; one or two short strokes may suffice. The included Thermometer will at this moment indicate the dew-point. So speedy is the abstraction of heat permitted to be by the long slender shape of its mercurial reservoir, that the second dulness may generally be relied on as indicative of the final reduction to the temperature of the dew-point.

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* Figs. 1, 2 in Plate XXX. give a correct idea of the whole instrument.

When the French shade is thus used, care must be taken that the air contained in it be at the same temperature and hygrometric condition as the air in which the experiment is made. The best way is to keep the French shade standing inverted, for a few minutes previously, near the Hygrometer.

Other advantages attend these arrangements:—The French shade prevents the commixture of aqueous exhalations from the breath and person of the operator with the air under trial. The operator may be as close as is necessary to the Hygrometer; he is relieved from the embarrassment of observing the descent of the mercury, and the formation of the first cloudiness on the silver at the same moment that he is occupied in regulating the stopcock of the aspirator, and doing all this at such a distance as to require the aid of a small telescope. In this mode of proceeding the telescope, the aspirator, its support, and the vessel of water are rendered unnecessary.

Many experiments have convinced me that the occasional and almost momentary adoption of the French shade has no effect in complicating the results; that it merely obviates the uncertainty arising from sudden gusts of wind, carrying variable quantities of vapour, and prevents the breath and exhalation of the operator from coming into immediate contact with the silver indicator, although, by mixing with the ambient air, it must ultimately do so; but not until it has been brought to the temperature of the vaporized ether by passing through it.

The grand difficulty in using all Hygrometers on the condensing principle is that of ascertaining with precision the moment when the first cloud appears on the polished silver or glass; practice will overcome it. A choice of situation with regard to the direction of the light is important. Although I have applied the word cloud to the change induced on the silver cylinder by condensation of the aqueous vapour on it, there really ought to be no actual obscuration of the polish; the Thermometer would then be below the dew-point. The change should not amount to more than an alteration in the hue of the silver, to be observed best by comparison with the half cylinder. The polish of both should be exquisite.

For the purpose of meteorological research, the apparatus, as hitherto described, would be difficult to manage, if not impracticable. To meet the exigencies of an open country, a mountain district, or the depths of a mine, the arrangements must be different. For these purposes, the part of the Hygrometer which contains the enclosed Thermometer and silver cylinder must be unscrewed from the stand, the remaining parts being not then required. The apparatus is furnished with two or three yards of vulcanized India rubber tube of the smallest bore, one end of which perforates a cork nicely fitted to the slightly tapering silver funnel through which ether is supplied to the silver cylinder; to the other end is attached a small stopcock, connected with a large flaccid bladder, or air bag, such as is commonly used for gases. The Hygrometer, thus fitted up, now constitutes an independent instrument, which may be used as follows:—Some ether (lightest) being poured in through the funnel, the cork holding the tube is to be inserted, and the instrument fixed in any convenient situation; the observer, stationed at a distance of several feet, places the inflated bladder under his arm or foot, and, moderately pressing it, regulates the passage of the air by the stopcock; and through a small telecope watches the effect until the first cloud appear on the silver. The telescope renders the degrees of the Thermometer, and the height of the mercurial column, distinct to even the eighth* of a degree; but the distance of the observer must be limited to that at which the first invasion of the tarnish on the silver can be perceived: for my own part, with a telescope, I could barely perceive the incipient cloud at the distance of eleven feet, in a most favourable light.

The action of the bladder is precisely the same as that of the aspirator or syringe; it is easily inflated, when the stopcock is removed, by a few expirations of breath.

Regnault was able to make several determinations of dew-point with his Hygrometer, in which "he obtained results perfectly identical in succesive determinations. The experiments were made in a large ampitheatre, of which the temperature and hygrometric condition changed very slowly." In my trials I could obtain but few identical results within an hour; many of them were made in the months of February and March, 1869, memorable for rain and storms; in the open air, during a calm, the indications scarcely varied half a degree in successive experiments during an hour. Indeed, under equal circumstances, it is difficult to see why there should be any variation; at the proper temperature, moisture will precipitate from the air, and bright silver will become dull without fail. The only source of uncertainty is the visual capability of the observer at the proper distance.

We come now to consider the use and application of the Psychrometer, or wet bulb Thermometer. The chief point to be attended to, in order to determine the dew-point and fraction of saturation, is the true depression of the mercury effected by the evaporation of water from what may be called the bulb. If the instrument be used by merely wetting the cambric envelope, and leaving it to spontaneous evaporation in still air, the maximum depression will not be attained. To produce the maximum effect, the bulb and its envelope must be exposed to a brisk current. When there is no natural current, an artificial one must be created, such as by a bellows, a fanner, or by swinging the bulb. Such a proceeding will reduce the mercury to the lowest degree that is possible by the action of the air. Even in the open air, unless the breeze be strong, artificial aid of this kind must be employed. As already observed, there is often great difficulty in coming to a just conclusion, in consequence of the rapid changes which the air experiences in temperature and hygrometric condition. It is to the case of the open air that the difficulty applies; for the experiment may be easily and correctly made when an artificial current is created. But in every case, even in a brisk breeze, it will be prudent to assist the evaporation by the fanner, so that the utmost depression may be certainly obtained. The kind of fanner is far from being immaterial; for not only must evaporation from the bulb take place, but the resulting aqueous vapour must be removed from the immediate vicinity of the evaporating surface. This will be best effected by the use of a large fanner. I found a strong pasteboard, eight inches square, with a firm handle fixed to one side, to answer best; it should be used by quick extensive swinging strokes, for such will generally sink the mercury half a degree lower than rapid short strokes. If a bellows be used, the nozzle must be kept about fifteen inches from the bulb; if very near, the blast will cause a slight elevation of the mercury, instead of a reduction, as was long ago observed by Cassini and de la Hire ("Memoirs of the Royal Acad., Paris," 1710).

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* Regnault reads off his Thermometer to one-tenth of a degree; but that is centigrade. The centigrade is to Fahrenheit as 1°·8 is to 1°.

I conceive that the want of agreement, noticed by Dr. Apjohn, between the observed and calculated dew-points, in some of his experiments ("Trans. of the Royal Irish Academy," vol. xvii., p. 291) is not attributable to the coefficient having been assumed too great, but that the depressions were too small; for he omitted to promote evaporation from the wet bulb by artificial means; yet such expedients are necessary to the attainment of the correct elasticity of the aqueous vapour.

Having thus described the two instruments which I have combined into one, it remains to make some observations on the question whether the Psychrometer is capable of affording true results by the adaptation of certain calculations to its indications. Many years since, Professor Apjohn communicated to the Royal Irish Academy a formula for finding the dew-point by the wet bulb Thermometer, and described many experiments which showed that the calculated dew-points agreed in a striking manner with those obtained by experiment. The following is his formula:—

$$f'' = f' - md + \frac{p}{30},$$

in which f'' is the tension of steam at the dew-point; f', its tension at the temperature of the wet bulb; d, the depression, or difference between the temperature of the air and wet bulb; *p*, the existing; and 30, the mean pressure; *m* is a coefficient depending on the specific heat of air and the caloric of elasticity of its included vapour, its arithmetical value being ·01149, or the equivalent vulgar fraction $\frac{1}{87}$, which he afterwards says he is "disposed to consider as more correctly represented by the fraction $\frac{1}{88}$," but has not been able fully to satisfy himself ("Phil. Mag." vii., 472). In constructing the following Tables, I have used the fraction $\frac{1}{88}$ as coefficient.

The other formula is that of Professor August, of Berlin, modified by Regnault ("Poggendorf Annal.," vol. v., 2 series, p. 69):

$$x = f - \frac{0 \,.\, 429\,(t - t')}{610 - t'} \,.\, h,$$

in which x is the elastic force of aqueous vapour actually in the air; f and f' are the elastic forces of the saturated vapour of water for the temperatures t and t'; t is the temperature of the air and dry bulb; t', the temperature of the wet bulb; h, the height of the barometer; $610—t'$ is the latent heat of the vapour of the water; the coefficient 0·429 requires occasional variation, as will be seen hereafter.

The following Table contains a few fractions of saturation calculated by Apjohn's formula, from his test experiments, using $\frac{1}{88}$ as the coefficient; in deducing them I have employed the elasticities of vapour given in Regnault's Tables, as interpreted and corrected for the latitude of Dublin by the Rev. R. V. Dixon. I have placed beside them the fractions of saturation, calculated by the modified formula of August, the French temperatures and pressures being converted into English equivalents:—

TABLE I.

Dry Bulb, Fahr.	Wet Bulb, Fahr.	Barometer.	Fraction of Saturation by Apjohn's Formula, derived from Test Experiments. Coefficient 88.	Fraction of Saturation by August's Formula, modified by Regnault's. Coefficient ·429.	Differences.
°	°				
78	62·2	30·30	0·395	0·383	0·012
90 5	67	30·15	0·274	0·271	0·003
68	60·3	30·42	0 635	0·627	0·008
72	62	30·51	0·561	0·552	0·009
98·5	71·5	30·36	0·251	0·240	0·011
77	65	30·51	0·515	0·507	0·008
69	58·6	30·30	0·527	0·522	0·005
72	60	30·30	0·485	0·474	0·011
92	69	30·42	0·295	0·288	0·007

These fractions coincide as nearly as could be expected, and some of them in a remarkable manner; and are, so far, calculated to inspire confidence in both the formulæ compared. But it is necessary to test them under other circumstances of temperature and moisture.

Regnault, in order to test the formula of August modified by himself, made many experiments in which the aqueous vapour was absorbed from a certain volume of atmospheric air, and weighed, the moisture of another portion of the same air being calculated, by the application of the formula to the indications of the Psychrometer. He has constructed a Table in which the fractions of saturation derived from both sources are given. The following Table contains a number of his determinations, converted into English temperatures, pressures, and elasticities; and beside each I have placed the fraction of saturation, derived from the same data, by means of Apjohn's formula, with coefficient 88.

TABLE II.

Dry Bulb, Fahr.	Wet Bulb, Fahr.	Barometer,	Fraction of Saturation by Weighing.	Fraction of Saturation by Apjohn's Formula. Coefficient 88.	Fraction of Saturation by August's modified Formula. Coefficient ·429.
°	°				
65·25	51·15	29·70	0·344	03·48	0·337
64·54	52·98	29·71	0·438	0·448	0·438
64·50	54·51	29·57	0·496	0·517	0·507
64·18	46·88	29·72	0·193	0·211	0·197
62·02	50·11	29·94	0·377	0·408	0·396
59·43	49·14	30·02	0·420	0·457	0·417
57·33	45·61	30·10	0·362	0·366	0·356
55·72	47·96	29·78	0·506	0·555	0·551
55·61	48·90	29·50	0·597	0·613	0·609
54·57	45·70	30·10	0·466	0·484	0·474
48·90	42·12	29·02	0·545	0·559	0·554
44·89	41·52	29·48	0·731	0·753	0·750

In the above Table the fractions of saturation obtained by Apjohn's and by August's modified formulæ agree tolerably well with the weights ascertained by Regnault. Both formulæ give fractions a little higher. But the following Table will show that the two formulæ disagree materially with the weights in the case of low temperatures and very humid atmospheres:—

TABLE III.

Dry Bulb, Fahr.	Wet Bulb, Fahr.	Barometer.	Fraction of Saturation by Weighing.	Fraction of Saturation by Apjohn's Formula. Coefficient 88.	Fraction of Satura- byAugust's modified Formula. Coefficient ·429.
°	°				
49·37	48·00	30·16	0·8734	0·8712	0·904
47·42	46·21	30·32	0·8533	0·8457	0·891
47·00	44·17	29·45	0·7436	0·8013	0·797
45·86	42·98	30·39	0·8406	0·7905	0·859
45·53	43·19	29·45	0·7659	0·8304	0·826
45·07	43·72	30·41	0·8503	0·8990	0·896
44·34	40·41	29·74	0·6193	0·7082	0·694
44·78	44·51	30·39	0·9626	0·9857	0·979
42·44	41·74	30·24	0·8314	0·9440	0·943
42·17	40·03	29·87	0·7576	0·8311	0·828
42·15	40·17	29·66	0·8035	0·8410	0·841
34·47	34·05	29·89	0·9877	0·9600	0·959
33·53	32·52	29·74	0·8183	0·9020	0·904

In these cases also the formulæ of Apjohn and August agree pretty nearly; but both give fractions of saturation very different from those obtained by Regnault's process of weighing the aqueous vapour of the atmosphere. The result of this process, used by Regnault as a test of the efficiency of August's formula, would no doubt be decisive if that result could be obtained by a momentary observation, and at the same moment in which the observations of the wet bulb were made, which is impracticable on account of the length of time required for the transmission of a sufficiency of the air operated on through the drying tubes. Regnault himself elsewhere says this method "does not give the quantity of humidity which exists in the air at a determinate moment." In an experiment of his, the passage of the air through the drying tube occupied an hour and a half: great changes may occur in that period.

We find from the preceding facts and considerations that the formulæ proposed by Apjohn and August for ascertaining the dew-point and fraction of saturation by the wet bulb Thermometer do not lead to a coincident result, and that Regnault's weighing process disagrees in general with both formulæ, and is not to be viewed as a test of either. So far as absolute precision is concerned, we may say that, of the three methods, not any one is supported by the testimony of either of the other two. It is to be regretted that under these circumstances Regnault did not adduce the evidence of his own "condenser," which tells its story at once without calculation or the introduction of uncertain quantities, although it is subject to errors arising from the difficulty of accurate observation. The only observations quoted by him, made with his condensing Hygrometer, are those of M. Izarin, which are to the full as discordant as any of the rest.

I have made a great number of experiments with my modification of the condensing Hygrometer, for the purpose of contrasting the dew-points observed by it with those determined by the wet bulb Thermometer. The following Table contains a selection of them, many being rejected on account of obvious mismanagement, mistakes, or doubts:—

TABLE IV.

Temperature of the Air.	Temperature of Wet Bulb.	Dew Point, calculated Co-efficient 88.	Dew Point by Condenser.
°	°	°	°
52·28	45·5	37·5	37·76
60·10	55·5	52·7	52·12
63·5	57·5	53·2	53·2
59·5	52·5	46·5	46·5
60·25	55·5	52·25	52·0
61·2	58	56·1	56·5
66	58	52·36	52
63	57·5	55	53
66·5	57	52·38	52·5
64·5	58	53·56	53·5
62·5	55·75	50·75	50·5
57·75	54·5	52	52·25
64	57·0	52·15	52·25
60·5	55·5	51·8	52·25
59	54	50·1	52·25
57·5	54·75	53·1	52·75
60·25	56	53	53
63	56·5	51·75	52
51·5	50·2	49	49·5
52·5	50·75	49·3	49·3
52	50·5	49·3	49·5
51·5	50·5	49·6	49·5
60·75	59·5	42·8	42

The condensing Hygrometer, founded as it is on an universally admitted principle, is no doubt, when *carefully made*, *skilfully manipulated*, and *correctly observed*, a reliable instrument for obtaining accurate information of the hygrometric condition of the atmosphere. The material employed as the indicator of atmospheric moisture by Le Roy, Dalton, and Daniell was glass, an hygroscopic substance in its own nature, and used as such in the Hygrometer of Hochheimer. But glass complicates, although in a very slight degree, the evidence of the instrument, by bringing chemical affinity into operation, and so far resisting evaporation, which, in this case, ought to be the only agent concerned. Polished silver is a much more perfect indicator than glass. It was first used half a century since by the author of the article "Hygrometry," in the "Edinburgh Encyclopædia," and afterwards by Regnault and others. The advantages of Regnault's arrangement are, that it is less troublesome, by not requiring calculation, reference to tables, or the aid of a barometer, and that it is more sensible to small changes.

I conceive that my modification of Regnault's instrument is not without advantages: it is more conveniently and generally applicable to its uses, more conducive to determinations under difficult or doubtful circumstances; it obviates the contingency of deteriorated results arising from the proximity of the experimenter, and it effects these objects with less consumption of ether—an expensive article in the British Isles. The essential parts, being small and compact, are fitted for the pocket on expeditions of research. It does not profess the extreme sensibility of Regnault's, with which its inventor can observe to the twentieth part of a centigrade degree; nor can I see much use in such sensibility, when used in an atmosphere which fluctuates every moment within a few yards of the instrument—so much so that, when a moist breeze is passing, the dew point cannot be ascertained at all: perhaps the eighths of a degree (discernible on my scale) is sufficient for any attainable object.

The Psychrometer, when intended for continuous action, should be so arranged that the cambric, being thoroughly wet, shall not let fall more than one drop in eight or ten minutes. The rate may be regulated by raising or lowering the glass fountain in the slide ring, or by taking a strand or two from the woollen thread which acts as a syphon. For observing the frequent variations of the hygrometric state of the atmosphere, this self-acting Psychrometer is very convenient. In proportion as the two Thermometers (one of them being wet) approach the same degree of their respective scales, we learn that the atmosphere becomes more moist; and if they arrived at the same degree, the fact would indicate that the atmosphere was, for that temperature, saturated with moisture. But this is a rare occurrence, if it ever happen: it never has occurred during my experience of several years. On one occasion, it had been raining for eighteen hours, sometimes heavily; at midnight I examined the instrument, which had been placed in the open air, outside a closed window: the dry bulb was 44·75, the wet bulb 44° 5′. The fraction of saturation was therefore ·981, and this was the nearest approach to saturation that ever fell under my observation. The same observation has been made by De Luc: he says: "The case of extreme moisture existing in the open transparent air in the day, even in time of rain, is extremely rare: I observed it (he says) only once, the temperature being 39°." ("Phil. Trans.," 1791).

I conceive that the mode above described has a great advantage over the common method of allowing a projecting tuft of the cambric to dip into a vessel of water placed underneath; for the temperature of the cambric is affected by its continuous connexion with the water beneath; but the water, in passing through the woollen thread, is cooled by evaporation to the same temperature as the Thermometer itself, and by the same means.

The difference of the indications of the two Thermometers expresses, numerically, the degree of atmospheric dryness at the moment to which it refers, and thus presents a scale the zero of which is saturation, the maximum being unascertainable.

LI.—MEGALITHIC REMAINS IN THE DEPARTMENT OF THE BASSES PYRENEES. BY LORD TALBOT DE MALAHIDE, President R. I. A.

[Read April 26, 1869.]

DURING my stay at Pau, I made the acquaintance of the Vicomte de Villemarqué, a distinguished antiquary of Brittany, who has given much attention to what they call Celtic antiquities. He informed me that within a short distance there were some remarkable monuments of this period—indeed, the only ones he was aware of south of the province of Poitou. We accordingly arranged for an expedition to visit them, and we were fortunate enough to secure as a companion General Sir Vincent Eyre, to whose ready pencil I am indebted for the accompanying sketches. I regret extremely that owing to circumstances we were not enabled to give as much time to the investigation of these monuments as I could wish. There was a good deal of snow on the ground, and I did not make any measurements, relying upon obtaining this information in detail from another source, in which I have been disappointed.

After passing the picturesque and woody sub-Pyrenean region, we emerged on the Val d'Ossau which leads to Eaux Bonnes, and stopped at Bielle. This is the site of a Roman town, and mosaics of that period have been discovered there.

However, neglecting them, we left the beaten road, and penetrated into the flanks of the main chain of the Pyrenees. The scenery was very fine, commanding as we did the beautiful Val d'Ossau, and enveloped by an amphitheatre of mountains. Between three or four miles from Bielle, we got into the snow, and found ourselves in a circular valley, with a stream running down, a humble chapel, and a plateau surrounded by a circle of chestnut trees, in the midst of which was the most remarkable of the circles which came under our observation. The spot is called, in the dialect of Beárn, *Hondaas de las Hadas*, or *Spring of the Fairies* (see Pl. xxxi.). In the month of May I understand that there are great festivities among the peasantry, who dance and amuse themselves under the trees. It is considered a blessed spot, and no evil spirit ventures to disturb their innocent enjoyments. The spring has a still holier character; it is under the protection of the Virgin Mary, and its waters were held to be a sovereign remedy against the rinderpest when it first invaded the South of Europe, about the middle of the last century. The chapel was then erected, and I believe the patron saint is considered to have exerted a prophylactic influence during the prevalence of the late *Peste bovine*.